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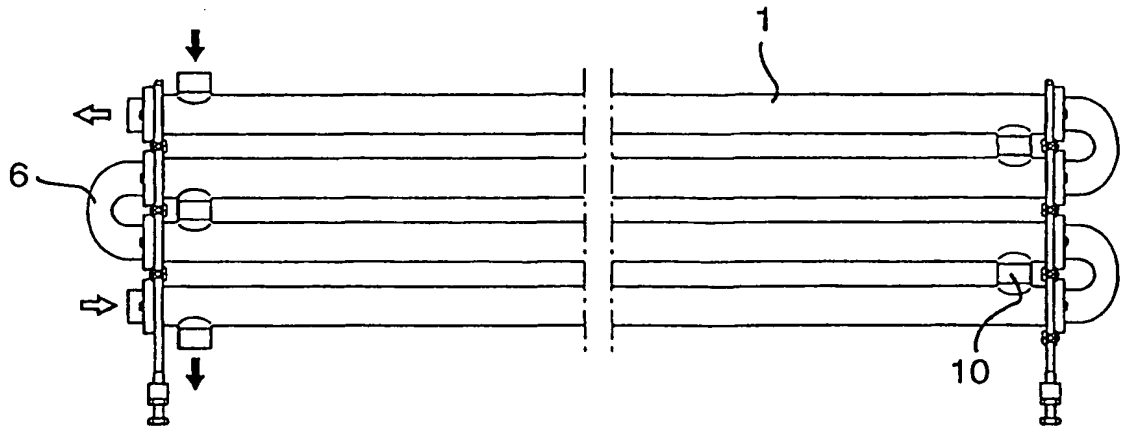
(54) Title: HEAT EXCHANGER



(57) Abstract

The invention relates to a heat exchanger which includes a plurality of heat exchanger elements (1) which are interconnected to form a flow system, partly for the product and partly for a heat transfer medium. The heat exchanger elements (1) are supported on a frame. Each heat exchanger element (1) consists of one or more heat transfer tubes (3) interconnected in each end with tube plates (4) to a product flow insert (5). The heat transfer tubes (3) are surrounded by a casing tube (2). Two adjacent product flow inserts (5) are interconnected by means of a product pipe bend (6) and two adjacent casing tubes are in turn interconnected by means of a connection member (10). The tube plates (4) constitute a part of the frame of the heat exchanger, flexibly interconnected with adjacent tube plates (4).

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International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	GB 905076 A (BABCOCK & WILCOX LIMITED), 5 Sept 1962 (05.09.62) --	2

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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INTERNATIONAL SEARCH REPORT

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.
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HEAT EXCHANGER

TECHNICAL FIELD

The present invention relates to a heat exchanger of the type which includes a plurality of heat exchanger elements carried by a frame and interconnected to one another in a flow system with a product flow and flow for a heat transfer medium, each heat exchanger element displaying, on the one hand, one or more heat transfer tubes interconnected by means of tube plates to form product flow inserts, and, on the other hand, a casing tube surrounding the heat transfer tubes, two adjacent product flow inserts being interconnected with one another by means of product pipe bends.

BACKGROUND ART

Heat exchangers, which exist in a multiplicity of types, are employed when the intention is to heat or cool a liquid product, for example with the aid of steam, water or other liquid at different temperatures. Heat exchangers come into use within various process industries and are also common occurrences in the food industries, such as dairies.

A well-known type of heat exchanger is the so-called tube heat exchanger which consists of one or more heat exchanger elements which are interconnected with one another in a flow system, with a product flow and a flow for a heat transfer medium. A heat exchanger element substantially consists of one or more heat transfer tubes surrounded by an outer casing tube. The heat transfer tubes are interconnected by means of a tube plate to form a unit, a product flow insert. Two adjacent product flow inserts are in turn interconnected by means of product pipe bends to form a product flow in order to be able to circulate the product which is to be heated or cooled in the process. The outer casing tubes are also interconnected in order to be able to circulate a heat transfer medium, such as water or other liquid, or steam or alternatively other gases.

In recent times, attempts have been made to modularise tube heat exchangers of the above-outlined type in order to realise a simpler assembly and to avoid each tube heat exchanger becoming "customised". Such a tube heat exchanger is described in Swedish Patent Specification SE 501 908.

OBJECTS OF THE INVENTION

One object of the present invention is to further simplify the modularised tube heat exchanger in order to create the possibility of competing with the plate heat exchanger which are common on the market and are considerably cheaper.

A further object of the present invention is to realise a tube heat exchanger which, despite its compact construction, is capable of taking up the thermal expansions which always occur in heat exchangers.

Yet a further object of the present invention is to realise a tube heat exchanger which is economical to manufacture and which is simple to install and maintain.

SOLUTION

These and other objects have been attained according to the present invention in that the heat exchanger of the type described by way of introduction has been given the characterizing feature that two adjacent casing tubes are interconnected by means of a connection member and that the tube plates constitute a part of the frame, flexibly interconnected with adjacent tube plates.

Preferred embodiments of the heat exchanger according to the present invention have further been given the characterizing features as set forth in the appended subclaims.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

One preferred embodiment of the heat exchanger according to the present invention will now be described in greater detail hereinbelow, with particular reference to the accompanying Drawings. In the accompanying Drawings:

Fig. 1 is a side elevation of a heat exchanger according to the present invention;

Fig. 2 is a side elevation of a part of a heat exchanger;

Fig. 3 is a side elevation, partly in section, of a product pipe bend;

Fig. 4 is a side elevation, partly in section, of a part of a heat exchanger element;

Fig. 5 is a plan view of a tube plate;

Fig. 6 is a plan view of a connection profile; and

Figs. 7-9 show different end elevations of heat exchangers.

The accompanying Drawings show only those parts and details essential to an understanding of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENT

Figs. 2 and 3 show the construction of the heat exchanger. A tube heat exchanger according to the present invention consists substantially of one or more heat exchanger elements 1. The heat exchanger normally consists of a number of these heat exchanger elements 1, interconnected with one another in a flow system. A heat exchanger element 1 consists of an outer casing tube 2 which surrounds one or more heat transfer tubes 3. The heat transfer tubes 3 are interconnected to one another at each end of the tubes 3 by means of a tube plate 4. A number of heat transfer tubes 3 with a tube plate 4 at each end constitutes a product flow insert 5. The casing tube 2 is, in both ends, welded to each respective tube plate 4.

Fig. 1 shows a number of heat exchanger elements 1 interconnected to form a heat exchanger. The heat exchanger has a flow for product, which is shown by means of white arrows, and a flow for a heat transfer medium, which is shown by black arrows. The heat transfer medium is to heat or cool the product, depending upon the process which is desired. The heat transfer medium may consist of water or other liquid of different temperature, or alternatively of steam or other gas. A heat exchanger according to the present invention may also be employed regeneratively, i.e. product is employed in both of the flows so that an already heated product heats the incoming cold product, and vice versa.

The product flow is circulated in the heat transfer tubes 3 which constitute the major part of the product flow inserts 5. Two adjacent product flow inserts 5 are interconnected by means of a product pipe bend 6, in that the product pipe bend is secured with a flange union in two adjacent tube plates 4. The product pipe bend 6 is preferably of elliptical cross section centrally between two product flow inserts 5, in point 7, and of circular cross section in both its ends. Alternatively, the product pipe bend 6 may be of circular cross section throughout its entire length. An elliptical product pipe bend 6 in accordance with the foregoing is described in detail in Swedish Patent Application SE 9703865-7.

The flow for the heat transfer medium is circulated through the casing tubes 2. In the proximity of both of their ends, the casing tubes 2 have a circular aperture 8 in the casing surface with a collar 9. The collar 9 corresponds with a connection member 10. The connection member 10 which substantially consists of a straight tube length, is bevelled in both its ends and provided with a gasket or O-ring 11. The collars 9 abut against the O-rings 11 in both ends of the connection member 10 and constitute a tight and, to some degree, a flexible union.

A tube plate 4 which constitutes a part of a product flow insert 5, is shown in Fig. 5. The plate 4 has modular adapted outer dimensions and, in its four corners, is provided with grooves 12. The grooves 12 correspond with a coupling profile 13 which is shown in Fig. 6. The coupling profile 13 is substantially cruciform. A coupling profile 13 may unite two, three or four tube plates 4.

In that the tube plates 4 in a heat exchanger are placed closely adjacent one another united by coupling profiles 13, there will be obtained a stable unit which constitutes a part of the frame of the heat exchanger. Various ways of placing four heat exchanger elements 1 are shown in Figs. 7-9. The heat exchanger elements 1 are placed on a lower frame section 14 with adjustable feet 15. The lower frame section 14 has grooves 16 corresponding to the grooves 12 in the tube plates 4. The tube plates 4 are locked against the lower frame section 14 by means of coupling profiles 13.

As a result of the design and thickness of the coupling profiles 13, each individual heat exchanger element 1 may move in its longitudinal direction. This is a necessity, since the heat exchanger elements are subjected to powerful thermal expansion. The connection members 10 may also move laterally to some degree and trials have shown that a tight union will be obtained despite oblique inclination against the O-rings 11. The corresponding oblique inclination would not be possible in, for example, a flange union.

As a result of the form of the product pipe bend 5 with an elliptical cross section centrally in the pipe bend 6, a further portion of the heat exchanger will be obtained which is capable of absorbing the thermal stresses in that the product pipe bend 6 is somewhat flexible in its form. A corresponding pipe bend of circular cross section throughout its entire length is not flexible at all.

By employing modular adapted tube plates 4 to which different casing tubes 2 may be connected, and by employing connection members 10 of different heights, there will be obtained a series of tube heat exchangers with different capacities which may be manufactured with a few simple parts. The heat exchanger will be simple to assemble, and service is simplified since it is not necessary to dismantle more than that heat exchanger element 1 which needs to be replaced.

The connection member 10 may be readily dismantled anywhere whatever in a complete heat exchanger, which affords a certain possibility for inspection. This is particularly important when the heat exchanger is employed regeneratively, i.e. when product is run against product. The connection member 10 is easy to maintain since it normally entails that only the O-rings 11 must be replaced. The connection member 10 is also relatively simple to manufacture given that the flexibility in the member 10 gives room for greater tolerances.

In the event of possible crack formation, because of stress corrosion which is a common occurrence in tube heat exchangers with fixed connections between the casing tubes 2, two casing tubes 2 must be replaced. The risk of crack formation in a heat exchanger according to the present invention is reduced in that the connection member 10 may take up a part of the thermal expansion. If crack formation were nevertheless to occur, only one casing tube 2 need be replaced.

As will be have been apparent from the foregoing description, the present invention realises a heat exchanger which is simple and economical to manufacture and which has great possibilities for taking up the thermal expansion which occurs in a heat exchanger.

WHAT IS CLAIMED IS:

1. A heat exchanger of the type which includes a plurality of heat exchanger elements (1) carried by a frame and interconnected to one another in a flow system with a product flow and flow for a heat transfer medium, each heat exchanger element (1) displaying, on the one hand, one or more heat transfer tubes (3) interconnected by means of tube plates (4) to form product flow inserts (5), and, on the other hand, a casing tube (2) surrounding the heat transfer tubes (3), two adjacent product flow inserts (5) being interconnected with one another by means of product pipe bends, characterized in that two adjacent casing tubes (2) are interconnected by means of a connection member (10); and that the tube plates (4) constitute a part of the frame, flexibly interconnected with adjacent tube plates (4).

2. The heat exchanger as claimed in Claim 1, characterized in that the product pipe bend (6) is of elliptical cross section at the centre of the bend (6).

3. The heat exchanger as claimed in Claim 1, characterized in that the tube plates (4) have grooves (12) in their four corners, said grooves (12) corresponding with substantially cruciform coupling profiles (13).

4. The heat exchanger as claimed in Claim 3, characterized in that the coupling profiles (13) are of a thickness which gives the heat exchanger elements (1) the possibility of moving in their longitudinal direction.

5. The heat exchanger as claimed in Claim 1, characterized in that the connection member (10) consists of a straight tube section with an O-ring (11) in each end.

6. The heat exchanger as claimed in Claim 1, characterized in that the tube plates (4), together with a lower frame section (14), constitute the frame of the heat exchanger.

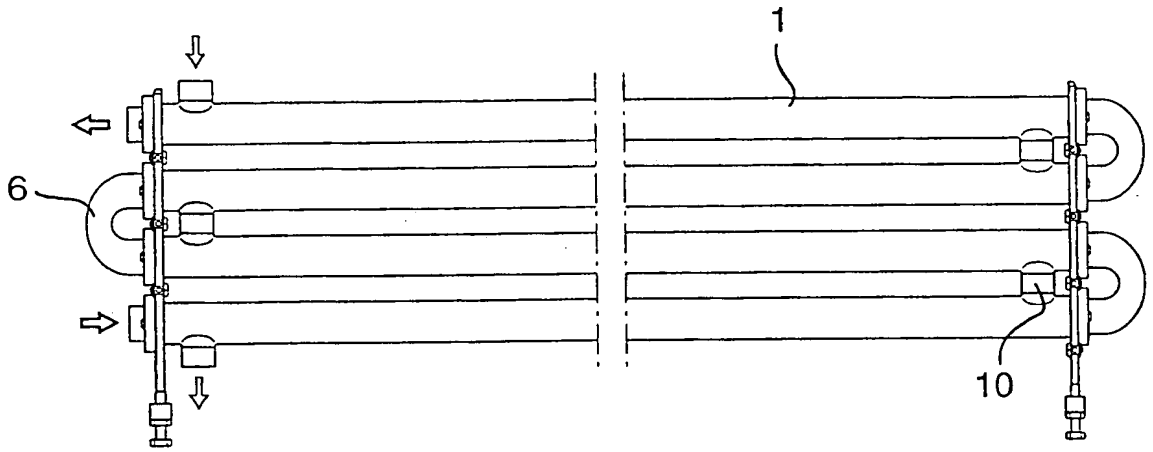

Fig 1

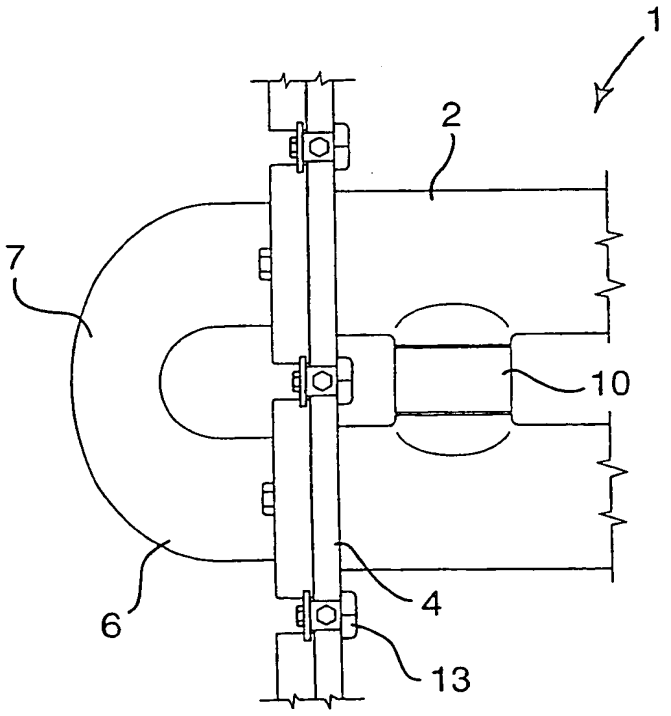

Fig 2

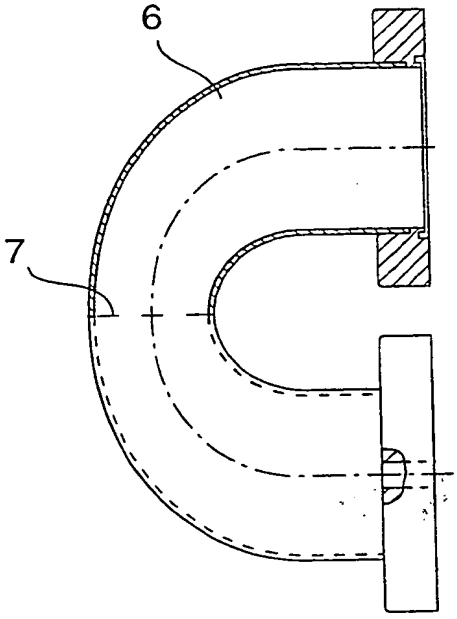

Fig 3

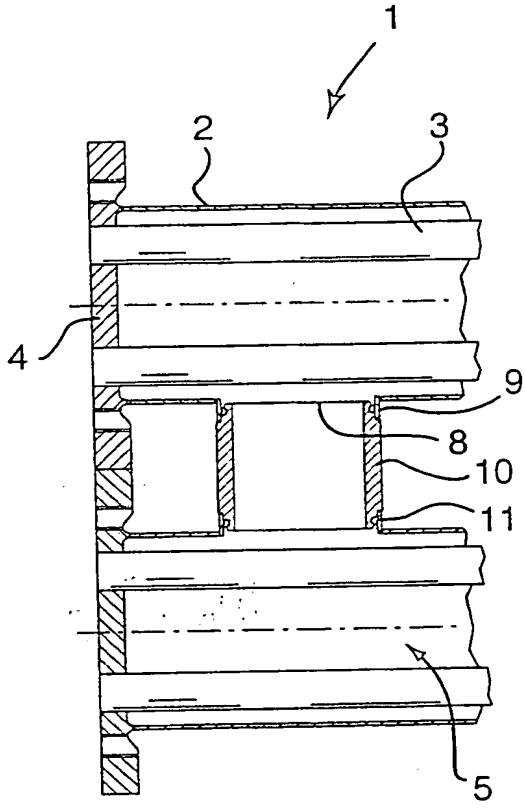

Fig 4

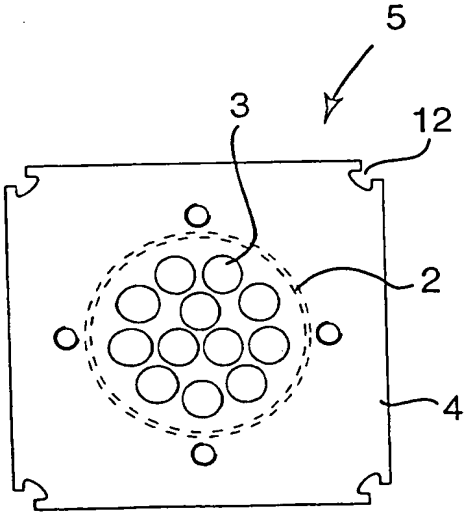

Fig 5

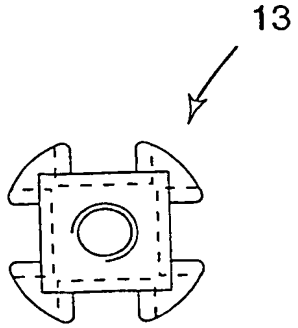

Fig 6

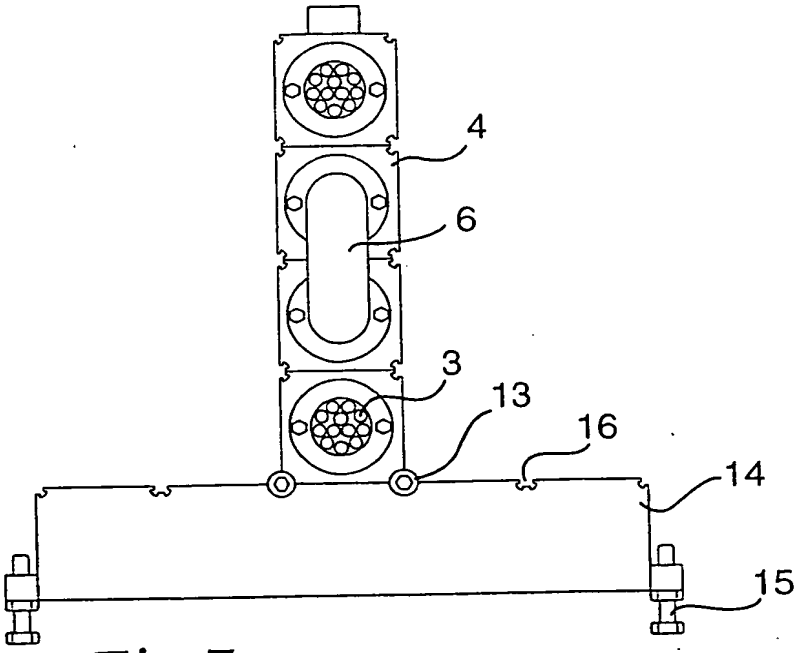

Fig 7

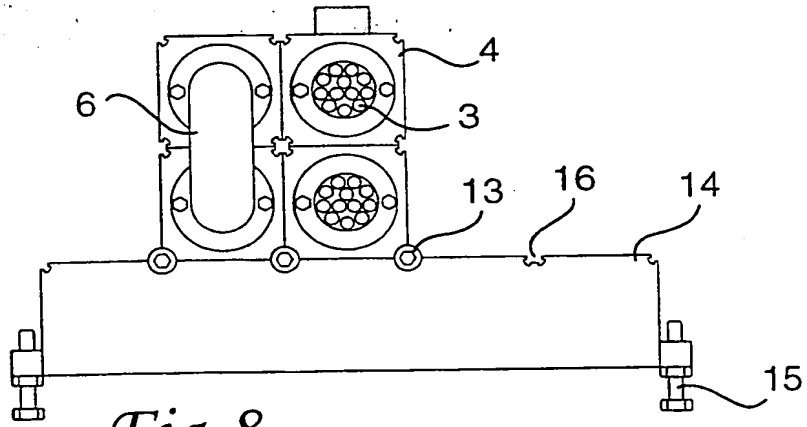

Fig 8

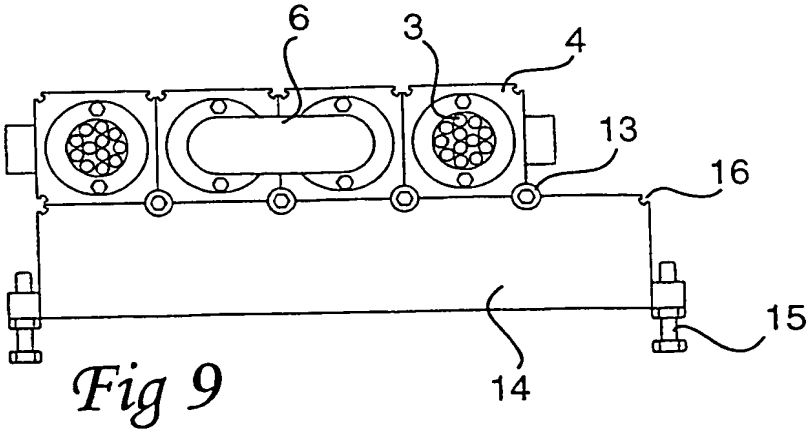

Fig 9

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